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Federal Communications Commission
Office of the Secretary

Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Advanced Television Systems and	)	MM Docket No. 87-268
Their Impact Upon the Existing	)	
Television Broadcast Service	)	

COMMENTS OF GENERAL INSTRUMENT CORPORATION

General Instrument Corporation ("GIC") submits these comments in response to the Second Report and Order and Further Notice of Proposed Rulemaking ("Further Notice") in the above-captioned proceeding[1].

INTRODUCTION

GIC is a proponent of two digital high definition television systems ("HDTV") and is working in concert with the Massachusetts Institute of Technology, which whom GIC formed the American TeleVision Alliance ("ATVA"). The first of these systems, the high definition DigiCipher™ ("DCHD") system was successfully tested by the Advanced Television Test Center ("ATTC") early this year. The second of these systems, CC DigiCipher™ ("CCDC") is scheduled to begin testing on or about August 11, 1992.

[1]FCC 92-174, released May 8, 1992.

GIC was the first to propose an all-digital HDTV system, in June of 1990. Following GIC's proposal, almost all other HDTV proponents changed their proposals to also offer all digital systems. GIC publicly demonstrated the first operational all-digital HDTV system in December, 1991 and was the first to successfully complete ATTC laboratory testing, in February 1992. GIC and the ATVA conducted the first over-the-air and cable transmission of a digital HDTV program, broadcast from the PBS station WETA and received at the United States Capitol. GIC demonstrated the first live digital HDTV broadcast and (in conjunction with Toshiba) the first digital consumer HDTV VCR, at the National Association of Broadcasters Show in Las Vegas in April, 1992. GIC also conducted the first public demonstration of the transmission of an all-digital HDTV system over a commercial, operating cable television system at the National Cable Television Show in Dallas, Texas, in May 1992.

NEW DEVELOPMENTS IN VIDEO CODING

We believe that the video coding technologies and RF modulation technologies submitted for testing at the Advanced Television Test Center represent the state of available technology.[2] We believe that there are no new or proposed technologies that offer important new benefits or are sufficiently concrete to be tested in the near term. We have attached an affidavit of Dr. Woo Paik, an expert in this area, which confirms this view. In particular, Dr. Paik believes that Orthogonal Frequency Division Multiplexing ("OFDM") is too complex a modulation method to be used in the U.S. ATV broadcast system. Moreover,

[2] Further Notice, ¶ 80.

he believes that the proposed video coding methods known as "wavelets" and "fractals" are significantly less efficient coding methods than the Discrete Cosine Transform and Huffman coding methods that are used in the DigiCipher HDTV system. As a result, while these methods may eventually be suitable for some video applications, they would not be able to achieve adequate quality for transmission of HDTV within a 6 MHz bandwidth.

CONSTRUCTION REQUIREMENTS AND CELLULAR TRANSMISSION APPROACHES

The CCDC system, submitted on behalf of ATVA, supports a cellular approach to broadcasting. With this approach, a broadcaster might employ one channel at numerous locations throughout its service area. The broadcaster would use low-power or medium-power transmitters to augment the area that is traditionally covered by a single high-power transmitter. In addition to allowing augmentation along the fringe of coverage, this approach is also useful for pockets within a service area which are terrain limited. A cellular approach is feasible with the CCDC system because it of its digital design and the particular adaptive equalizer that is employed. This approach is also feasible with the DigiCipher system of GIC. The Advisory Committee has begun an investigation of the economic and operational feasibility of this approach, and ATTC multipath tests will address the technical feasibility.

The Further Notice addresses broadcaster construction requirements, but does not contemplate that a broadcaster might choose to construct multiple transmitters with a lower power than might ultimately be permitted for a single transmitter. We urge the Commission

to grant broadcasters adequate flexibility to employ a cellular approach if it is determined to be feasible.

We note that Section 73.685 of the Commission's Rules (47 CFR §73.685) requires an NTSC station to place a minimum field strength signal over the entire principal community to be served. Because the rule now contains specific power levels that apply to NTSC, it would have to be amended if it were to apply to HDTV as well. But we suggest that it should not be applicable to HDTV, particular during the early years of HDTV implementation, or it could act as a barrier to a phased-in cellular implementation.

ENCRYPTION

The Commission has sought comment on the ability of ATV proponent systems to encrypt cable programming.[3] As the Commission is aware, GIC is an industry leader in video scrambling and conditional access systems for both the cable industry and the home satellite dish industry.[4] We have designed both the DigiCipher and the CCDC HDTV systems to be fully compatible with cable and home satellite dish distribution. Moreover, both systems fully support the use of digital scrambling or encryption methods.

As we have in the past, however, we wish to again call the Commission's attention

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[3] Further Notice, ¶ 75.

[4] See, for instance, FCC Report, Gen. Dkt. 86-336, FCC 87-62, adopted February 12, 1987.

to the problems of exporting digital encryption technology from the United States. The United States' export control regime, as administered under the International Traffic in Arms Regulations (22 CFR 120-130), treats digital encryption techniques as "munitions" whose export is either banned or tightly constrained. In the past, this policy has affected the competitiveness of U.S. high-tech manufacturers in the world marketplace, and it may continue to do so.

AUDIO DEVELOPMENTS

The Commission has noted that audio is an essential aspect of an HDTV system, and that a five-channel digital audio system may be feasible.[5] The two ATVA HDTV systems can support either a two-channel or a five-channel system. (A five-channel system consists of Left, Center, Right, Left Rear and Right Rear channels.) As the Commission has noted, the data rate needed to support these alternatives is about the same. Consequently, if they offer equivalent sound quality, the choice may be made based on which audio system is more extensible. We are not aware of any plans to test the sound quality of a five-channel audio system.

We believe that a five-channel system is more extensible than a two-channel system. This is because a five-channel data stream can be decoded to support any of the following combinations of speakers: Center only, Left and Right only, Left and Center and Right, and as well as all five channels to support true surround sound. In contrast, a two-channel data

[5] Further Notice, ¶ 79.

stream can support only Left and Right (Center can be simulated by adding Left and Right; a two channel scheme can support pseudo surround sound). Consequently, with a five-channel system, a consumer may start with a monaural receiver (one speaker) or stereo receiver (two speakers) and migrate to a more elaborate installation, but this is not possible if the Commission adopts a two-channel audio system as part of the standard.

UPCONVERTERS AND DOWNCONVERTERS

We believe that upconverters will be widely available to broadcasters[6] so that they may use NTSC cameras to produce programming, and transmit that programming on both their NTSC and ATV channels. ATV cameras are likely to be expensive in the early years, particularly if the Commission chooses a progressive system rather than an interlace system. There will be a demand for upconverters because of the cost of cameras, and we believe that some professional equipment suppliers will be prepared to meet that demand. We stand ready to work with such entities to help them design upconverters to work with our DigiCipher and CCDC systems.

A downconverter,[7] would take a compressed ATV signal and transcode it so that it could be displayed on an NTSC receiver. A downconverter would probably need to use many of the same electronic components as an ATV receiver. The electronics cost of downconversion, while not insignificant, will not be a major cost compared to that of the

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[6]Further Notice, ¶ 66.

[7]Id.

picture tube and deflection system. Downconversion might have potential benefits which would facilitate the transition to ATV. The market could be stimulated by factors such as different programming. Moreover, through the use of downconverters, consumers could get performance improvements. For instance, existing receivers with baseband input capability might get widescreen programming and experience better resolution and fewer NTSC artifacts, improvements attributable in large part to digital transmission. Indeed, availability of downconverters addresses the essence of previous EDTV proposals, while avoiding a two-stage introduction of full HDTV.

SUMMARY AND CONCLUSION

There are no new technologies applicable to HDTV other than those currently being tested at ATTC which offer important new benefits or which are sufficiently concrete that they can be tested.

The Commission should give serious consideration to the usefulness and application of cellular approaches to the broadcasting of digital HDTV.

Audio, interoperability and encryption, and the availability of conversion hardware are areas where Commission action may or may not prove necessary. The Commission should, as it has in the past, maintain its interest in the practical and commercial factors which are crucial to the introduction of these new technologies. As the Commission has recognized, a regulatory regime does not have to be extensive to be mindful of such

considerations.

Respectfully submitted,

Quincy Rodgers
Associate General Counsel
General Instrument Corporation
1899 L Street NW, 5th Floor
Washington, DC 20036
202-833-9700

Jeffrey Krauss
Consultant
17 West Jefferson Street
Suite 106
Rockville, MD 20850

Date: July 17, 1992

GENERAL ACKNOWLEDGMENT NO. 201

State of California }
County of San Diego } SS.

On this the 13th day of July 1992, before me,
CAROL WAKEFIELD,
the undersigned Notary Public, personally appeared
Woo Paik,

OFFICIAL SEAL
CAROL WAKEFIELD
Notary Public-California
SAN DIEGO COUNTY
My Comm. Exp. Nov. 6, 1992

☑ personally known to me
☐ proved to me on the basis of satisfactory evidence
to be the person(s) whose name(s) _____ subscribed to the within instrument, and acknowledged that _____ executed it.
WITNESS my hand and official seal.

Carol Wakefield
Notary's Signature

ATTENTION NOTARY: Although the information requested below is **OPTIONAL**, it could prevent fraudulent attachment of this certificate to another document.

THIS CERTIFICATE MUST BE ATTACHED TO THE DOCUMENT DESCRIBED AT RIGHT:

Title or Type of Document Affidavit
Number of Pages 1 Date of Document 7/13/92
Signer(s) Other Than Named Above none

NATIONAL NOTARY ASSOCIATION • 8236 Remmet Ave. • P.O. Box 7184 • Canoga Park, CA 91304-7184

Affidavit of Woo H. Paik

I, Woo H. Paik, being duly sworn, do depose and state as follows:

My name is Woo H. Paik and I am Vice President, Advanced Development of the VideoCipher Division of General Instrument Corporation. I am responsible for developing the digital compression algorithm, computer simulation and real time hardware for the DigiCipher™ HDTV and the Channel Compatible DigiCipher™ HDTV systems. In addition, I am one of the co-inventors of the VideoCipher Satellite television encryption that is used for C-band satellite distribution.

Since joining a predecessor company, Linkabit, in 1978, I have led numerous development programs in the areas of military and commercial satellite communications and digital signal processing.

I hold a degree of Doctor of Philosophy in electrical engineering from Massachusetts Institute of Technology.

I understand that the FCC's Advisory Committee on Advanced Television Service has conducted a review of potential new developments in high definition television technology, and has concluded that there are no new developments that are sufficiently concrete to be contemporaneously tested with the systems now being judged.

I agree with that conclusion.

I have independently reviewed and assessed the state of video coding technology. I believe that the techniques and technologies employed in the four digital HDTV systems now being considered are far more likely to result in a high quality affordable HDTV system than any other approaches that have been proposed.

I have reviewed a proposed modulation approach known as Coded Orthogonal Frequency Division Multiplexing (COFDM), and I believe that this approach is far too complex for economical use in a consumer television broadcasting system. The COFDM uses multiple low speed carriers to combat multipath and frequency selective fading. While the approach could be considered for digital audio broadcasting, the required complexity would become prohibitive for digital HDTV systems since it would require 500 or more 32-QAM modulated carriers to support the higher data rate requirements.

I have reviewed proposed video coding approaches known as fractals and wavelets, and I believe that these approaches are less efficient coding methods than the Discrete Cosine Transform and interframe coding methods that are employed in the DigiCipher™ and Channel Compatible DigiCipher HDTV systems. While these methods may eventually be suitable for some video applications, they would not be able to achieve adequate quality for transmission of HDTV within a 6 MHz bandwidth.

In summary, there are not technologies that are likely to be available for testing and offer a likelihood of better performance than the technologies now being tested.

Date: July 13, 1992 Signed: Woo H. Paik
Woo H. Paik

Subscribed and sworn before me this 13th day of July 1992.

Carol Wakefield
Notary Public

My commission expires 11/6/92

OFFICIAL SEAL
CAROL WAKEFIELD
Notary Public-California
SAN DIEGO COUNTY
My Comm. Exp. Nov. 6, 1992